Abstracts from the 2012 Midwestern Vascular Surgical Society Annual Meeting

Comparison of Hospital Readmission for Carotid Interventions

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Objective: Interventions for carotid artery disease are typically well tolerated and involve an overnight admission. Few studies have evaluated rates of readmission in the Medicare population comparing less invasive carotid artery stenting (CAS) with traditional open carotid endarterectomy (CEA). The objective of this study was to evaluate readmission rates after CEA and CAS and identify predictors of readmission.

Methods: MedPAR data (2005-2009) were used to select patients who underwent CEA or CAS according to International Classification of Diseases-9th Edition-Clinical Modification codes. Readmission within 30, 60, and 90 days from time of procedure was determined. Sociodemographic characteristics and Elixhauser comorbidity measures were used to adjust for confounding. Patients who received CEA and CAS were compared with χ^2 and multivariable logistic regression analysis.

Results: A total of 235,247 carotid interventions were performed (211,118 CEA and 24,129 CAS). Readmission rates for CEA and CAS patients, respectively, were 8.84% and 11.11% at 30 days ($P < .0001$), 13.31% and 17.98% at 60 days ($P < .0001$) and 16.86% and 22.68% at 90 days ($P < .0001$). Less than half of patients were women (43%) and were more likely to be readmitted during 30 days after discharge ($P = .001$). After adjustment for age, race, gender, comorbidities, and procedure, patients aged >80 years (odds ratio [OR], 1.25; 95% confidence interval [CI], 1.20-1.30) and patients with renal failure (OR, 1.6; 95% CI, 1.56-1.73), congestive heart failure (OR, 1.6; 95% CI, 1.57-1.73), or diabetes (OR, 1.4; 95% CI, 1.27-1.52) were more likely to be readmitted. In addition, patients who underwent CAS were 1.2 times as likely to be readmitted (95% CI, 1.15-1.25) as patients who received CEA. Diagnoses at readmission were similar between groups.

Conclusions: Interventions for carotid artery disease had a high overall readmission rate. After adjustment for comorbidities, use of less invasive techniques (CAS) was not associated with decreased readmission. Patients who underwent CAS were more likely to be readmitted than those who received CEA at 30, 60 and 90 days. Predictors of readmission included advanced age, congestive heart failure, renal failure, and diabetes. Further research is needed to determine strategies to reduce hospital readmission rates after carotid interventions.

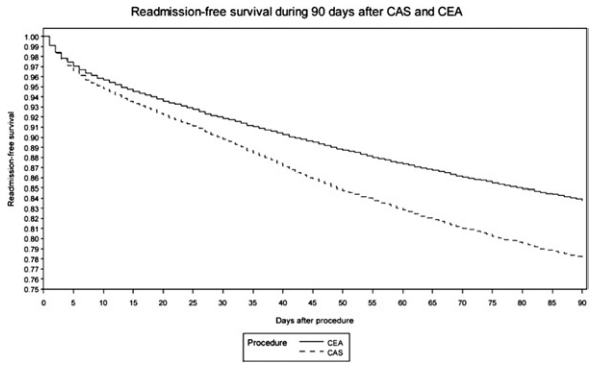

Fig.

Contemporary Outcomes After Distal Vertebral Reconstruction

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Objectives: Flow-limiting lesions or embolic phenomena can both produce vertebrobasilar ischemia. This study aims to differentiate the pathophysiology of vertebral ischemia and examine contemporary outcomes of distal vertebral reconstruction.

Methods: Thirty-seven consecutive distal vertebral artery (VA) reconstructions were performed in 34 patients between February 2005 and November 2011, including bypass to the third portion of the VA (V3) at the C1-2 level (n = 24) or the C0-1 level (n = 4); transposition of the external carotid artery or its occipital branch onto V3 (n = 6); transposition of V3 onto the internal carotid artery (n = 3); and bypass from the ipsilateral subclavian artery to V3 (n = 1). Five patients required a concomitant carotid intervention, and three patients required a partial resection of the C1 transverse process. Symptoms, present in 94% of patients, were attributed to a flow-limiting lesion in 75% (n = 24) and to embolization in the remaining 25% (n = 8).

Results: Intraoperatively, five patients required graft revision or conversion of a transposition to a bypass and two patients required vertebral ligation. Median blood loss was 238 mL. Hospital length of stay averaged 2 days. Postoperatively, one patient required re-exploration for bleeding (2.7%), and one patient suffered stroke (2.7%). Two patients had cranial nerve injury (5.4%). There was no perioperative mortality. After a mean follow-up of 28 months, 91% of patients experienced symptom improvement. Of the 28 patients who underwent follow-up imaging, cumulative primary patency was 83%, cumulative primary-assisted patency was 93%, and cumulative secondary patency was 97% (Fig). There were two late deaths of unknown etiology and no late strokes identified.

Conclusions: Distal VA reconstruction for flow-limiting or embolic lesions provides excellent long-term patency and stroke protection.

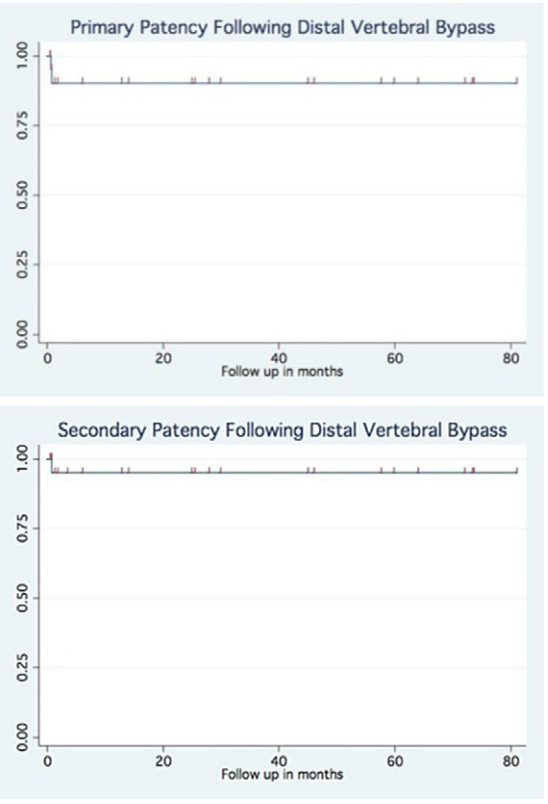

Fig.

Functional Analysis of Mesenchymal Stem Cells in Ischemic Conditions

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Objectives: Mesenchymal stem cells (MSCs) are currently used clinically in cell-based therapies to treat critical limb ischemia via intramuscular injection, an environment characterized by hypoxia, elevated levels of oxidative stress, and inflammation. In this investigation we compared MSCs from various tissue sources to assess sensitivity in various in vitro assays that may predict potency in vivo.

Methods: MSCs from adult bone marrow (BM-MSCs), adipose tissue (ASCs), and term placenta (P-MSCs) were isolated and characterized using culture assays and flow cytometry. MSCs were exposed to hydrogen peroxide (H_2O_2), tumor necrosis factor-α (TNF-α), and hypoxic conditions (1% oxygen). MSCs were analyzed based on the rate of apoptosis, senescence, overall survival, and vascular network formation. Apoptosis was measured by annexin V expression via flow cytometry. Expression of β-galactosidase was detected by light microscopy to quantify senescence. Overall survival was measured via spectrophotometer detection of methylene blue staining.

Vascular networks were created with endothelial colony-forming cells derived from cord blood.

Results: MSCs from various tissue sources demonstrated appropriate stem cell markers via flow cytometry. P-MSCs exhibited increased apoptosis in response to H_2O_2 compared with ASCs and BM-MSCs ($P < .001$). ASCs demonstrated increased apoptosis after exposure to TNF-α and hypoxia compared with MSCs ($P < .001$). No difference in senescence activity was detected by various MSCs. ASCs demonstrated elevated overall survival in response to H_2O_2 ($P < .05$). BM-MSCs and P-MSCs exhibited increased survival after exposure to TNF-α and hypoxia ($P < .001$). ASCs exhibited no difference in tube formation after exposure to H2O2 compared with controls. However, ASCs exhibited significant decreases in mean tube length after exposure to TNF-α and hypoxic conditions compared with controls ($P < .05$).

Conclusions: ASCs remain potent under oxidative stress conditions, whereas P-MSCs and BM-MSCs thrive under inflammatory and hypoxic conditions. This report outlines how MSCs respond to various conditions unique to vascular injury and indicate that ASCs may be the optimal cell source in critical limb ischemia, because oxidative stress is the dominant factor determining cell viability in this condition.

Clinical Evaluation of Suspected DVT Guides the Decision to Prophylactically Anticoagulate but Does Not Impact the Decision to Perform After-Hours Duplex Venous Scanning or Increase Its Yield

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Objectives: The utility of after-hours duplex venous scanning (DVS) for suspected DVT in emergency department (ED) patients has been debated. Availability of safe, prophylactic, low-molecular-weight heparin, cost containment efforts, and retention of scarce sonographers have to be balanced against 24/7 demand for services. We determined the incidence of DVT in DVS ordered after hours, correlation between the Wells score and prophylactic anticoagulation, as well as urgently performed DVS, and complications of delaying DVS until regular hours.

Methods: Records of all ED encounters between July 1, 2009 and June 30, 2010 associated with a DVS ordered after hours were reviewed. The decisions to prophylactically anticoagulate and whether to perform DVS urgently or delayed until regular hours were at the discretion of the ED physician and a vascular surgeon. DVS findings, number of urgent and delayed studies, the Wells scores, D-dimer levels, and outcomes were recorded.

Results: DVT was found in 12% (n = 22) of 181 DVS ordered after hours. DVT was found in 19% of 42 DVS done urgently and in 10% of 139 DVS delayed an average 10 hours 17 minutes (P = NS). Wells scores were available for all patients and D-dimer levels for 43 (Table). Seventy-eight percent of patients with a Wells score ≥3 had prophylactic anticoagulation, whereas only 40% of patients with a Wells score <3 had prophylactic anticoagulation ($P = .0001$). In contrast, 36% of patients with a Wells score ≥ 3 had urgent DVS and 20% of patients with a Wells' score <3 had urgent DVS (p = ns). Prophylactic anticoagulation was given to 86% of patients eventually found to have DVT versus 40% of patients eventually found to have no DVT ($P < .0001$). There were no PEs or bleeding complications.

Conclusions: The incidence of DVT in ED patients who had urgent after hours DVS was no different than in those whose DVS was delayed until regular hours. High pretest probability can be achieved with clinical evaluation prior to DVS, and this guided the decision to prophylactically anticoagulate but did not impact the decision to perform urgent DVS. Most patients eventually found to have DVT did receive prophylactic anticoagulation, and delay of DVS did not result in complications. We believe that most patients in whom there is high clinical suspicion for DVT can safely get prophylactic anticoagulation and delayed DVS. Patients in whom there is low clinical suspicion should not get urgent DVS.

Table. Wells score and D-dimer results

Variable	*Wells score ≥ 3 (%)*	*D-dimer (%)*
Sensitivity	64	100
Specificity	88	17
Positive predictive value	42	9
Negative predictive value	95	100

Asymptomatic 50% to 75% Internal Carotid Artery Stenosis in 288 Patients: Risk Factors for Disease Progression and Ipsilateral Neurologic Symptoms

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Objectives: This study evaluated the safety of an observation protocol in asymptomatic patients with moderate internal carotid artery stenosis, and to identify characteristics associated with disease progression.

Methods: Patients with asymptomatic moderate internal carotid disease (peak systolic velocity [PSV] > 125 cm/s and end diastolic velocity [EDV] <125 cm/s by duplex ultrasound imaging) correlating to 50% to 75% diameter reduction were monitored for 3 years. Progression to greater than 75% diameter reduction (EDV > 125 cm/s) or presentation with focal neurologic symptoms (stroke, amaurosis fugax, transient ischemic attack) was documented. Comorbidities, smoking status, and medications were recorded. Log-rank testing, Wilcoxon models, and Kaplan-Meier plots provided statistical analysis.

Results: During follow up, 26 of 288 patients (9%; 137 men, 151 women) developed symptoms (stroke: 9 [3.1%]; transient ischemic attack: 3 [1%]; amaurosis fugax: 3 [1%]), or asymptomatic increase in diameter to >75% (11 patients [3.8%]). All-cause mortality was 11% (33 patients). Seventeen patients (5.9%) underwent carotid endarterectomy and five (1.7%) had carotid stent placement. The event incidence was significantly higher for men ($P = .02$), but survival was not different. The rate of disease progression or development of symptoms was 5.5% at 12 months and increased to 7.2% by 24 months. Comorbidities with the highest associated event incidences were coronary artery disease (8.1%), hyperlipidemia (7.3%), and hypertension (6.7%). Medications associated with lower event incidences were insulin (2.8%) and angiotensin-receptor blockers (1.9%).

Conclusions: Sequential surveillance of asymptomatic patients with moderate carotid disease is safe, with only 5% becoming symptomatic and 4% having disease progression. Male patients with coronary artery disease, hyperlipidemia, and hypertension are at increased risk and are candidates for frequent screening and/or early intervention.

Deep Venous Thrombosis After Saphenous Endovenous Radiofrequency Ablation: Is It Predictable?

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Objectives: Endovenous radiofrequency ablation (RFA) is a safe and effective treatment for varicose veins secondary to saphenous reflux. Deep venous thrombosis (DVT) is a known complication of this procedure. The purpose of this study is to describe the frequency of DVT after RFA and associated predisposing factors.

Methods: We performed a retrospective data analysis from December 2008 to December 2011, during which 277 consecutive office-based RFA were performed in our institution using the VNUS ClosureFast catheter. Duplex scans were completed 2 weeks postprocedure in all patients to confirm saphenous vein obliteration and evaluate the deep venous system for thrombosis. Risk factors assessed for development of DVT included greater vs lesser saphenous, side treated, number of cycles used, hypercoagulable state, history of DVT, tobacco use, medications (oral contraceptives, aspirin, warfarin, clopidogrel), and vein diameter at the junction of the superficial and deep systems.

Results: Seventy percent of the patients were female, 56% were right side, and 86% were performed on the greater saphenous vein. Mean age was 54 ± 14 (range, 23-88 years). 3% of patients had a diagnosis of hypercoagulable state and 8% had a history of DVT. Follow-up ultrasound imaging showed thrombus protrusion into the deep system without occlusion was present in 11 patients (4%). DVT, as defined by thrombus protrusion with complete occlusion of the femoral or popliteal vein, developed in two patients (0.7%). Previous DVT was the only factor associated with DVT ($P = .018$). Although not statistically significant, there was a trend toward higher risk of DVT in LSV patients. Factors associated with protrusion into the deep system were lesser saphenous vein ($P = .035$), and factor V Leiden ($P = .026$).

Conclusions: The use of RFA to treat patients with saphenous reflux involves a small but definite risk of DVT. This study demonstrates that the risk of DVT or any thrombus protrusion in to the deep system is greater in patients with previous DVT, factor V Leiden, and treatment of the lesser saphenous vein. Periprocedural anticoagulation should be considered in this subset to reduce the risk of complication after RFA.

Response of Neointimal Hyperplasia and the Adventitial Sca1$^+$ Stem Cell to Nitric Oxide

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Objectives: Recently, Sca1+ stem cells have been identified to reside in the adventitia of the arterial wall. However, their role in the formation of neointimal hyperplasia is unknown, as is the effect of nitric oxide (NO) on these cells. We hypothesize that Sca1$^+$ stem cells contribute to neointimal development and that NO limits the involvement of adventitial Sca1$^+$ cells in the arterial injury response, thereby inhibiting neointimal hyperplasia.